EXHIBIT 6

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HONORABLE JOHN C. COUGHENOUR

UNITED STATES DISTRICT COURT
FOR THE WESTERN DISTRICT OF WASHINGTON

WASHINGTON TOXICS COALITION, NORTHWEST COALITION FOR ALTERNATIVES TO PESTICIDES, PACIFIC COAST FEDERATION OF FISHERMEN'S ASSOCIATIONS, and INSTITUTE FOR FISHERIES RESOURCES,	)	Civ. No. C01-0132C
Plaintiffs,	)	DECLARATION OF RICHARD D. EWING, PH.D.
v.	)	
ENVIRONMENTAL PROTECTION AGENCY, and CHRISTINE TODD WHITMAN, ADMINISTRATOR,	)	
Defendants.	)	

I, Richard D. Ewing, Ph.D, hereby declare as follows:

1. I am a fish biologist with expertise on the impacts of pesticides on salmon. I obtained my Ph.D. in cellular and molecular biology in 1968. After conducting research at Oak

Ridge National Laboratory and Oregon State University, I worked as a physiologist and hatchery specialist at Oregon Department of Fish and Wildlife from 1975-1992. In 1992, I formed Biotech Research and Consulting, Inc., which specializes in hatchery operations and chemical analyses related to fisheries. My curriculum vitae is attached as Exhibit 1.

2. I am the author of Diminishing Returns: Salmon Decline and Pesticide, which was released in February 1999 (Exhibit 2). In writing that report, I conducted a review of the published literature, government surveys and reports, pertaining to the impacts of pesticides on salmon and steelhead. That report is true and correct to the best of my knowledge. Since completing Diminishing Returns, I have continued to follow the published literature on this subject.

3. This declaration describes: (1) ways in which pesticides affect salmon; and (2) evidence that particular pesticides may adversely affect salmon.

IMPACTS OF PESTICIDES ON SALMON

4. Pesticides include multiple classes of chemical and biological agents that are purposefully introduced into the environment for a variety of reasons. They include insecticides, herbicides, and fungicides. Pesticides can move from the site of application to waterways through several means. Pesticides, particularly those that are highly soluble, may travel through surface run-off during rainfall events. Soluble pesticides may also infiltrate into the soil and subsequently enter ground water or subsurface runoff. From there, they can eventually travel to waterways. Pesticides that are less soluble tend to adsorb to soil particles and reach waterways in suspended sediments when erosion occurs. Finally, spray drift may result in significant pesticide contamination of both soil and water.

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5. Pesticides in streams typically reach high levels for short periods of time but may then decrease to low or undetectable levels, although some pesticide residues may persist at significant levels. During periods of high concentration, damage to aquatic organisms may occur. Low level exposure over time can also cause adverse effects.

6. Fish are particularly vulnerable at early stages when their sex characteristics, immune system, bone structure, and organ systems are developing.

A. ACUTE EFFECTS

7. As part of its registration of pesticides, the Environmental Protection Agency ("EPA") requires the chemical manufacturer to supply studies of the pesticide's short-term acute toxicities to fish and aquatic animals. These acute toxicity studies (known as the LC_{50}) provide the concentrations of the pesticide chemical that kills 50% of the test species within 48 or 96 hours. These tests are performed on a variety of test species, including selected fish species and aquatic invertebrates.

8. At certain pesticide concentrations in water, which may be lower than the LC_{50}, fish kills result. In <u>Diminishing Returns</u> (at 17-18), I provided several examples of pesticide spills that resulted in catastrophic kills of salmonids. Other examples of fish kills for other species are abundant in the literature. It is possible for lethal concentrations of pesticides to result from normal use.

B. SUBLETHAL EFFECTS

9. Sublethal effects are those that result from exposure to a pesticide in an amount that is not high enough to cause death, but can cause damage to an organism in other ways, such as physiological and behavioral changes that can ultimately impact survival. During and

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immediately after storm events, pesticide residues are more likely to be detected in water and the concentrations are more likely to present ecological risks. These effects can occur throughout the entire life history of salmonids, from the hatching of eggs, growth and maturing of young salmon, migration of juveniles to the ocean, and return of adults for spawning. It is felt by many toxicologists that sublethal concentrations may be more important to survival of populations of fish than lethal concentrations. Murty (1986) states that "Mass mortality of fish due to pesticide exposure is rare . . . . More commonly, fish are subjected to long-term stress arising from exposure to sublethal concentrations. In the long run, these sublethal concentrations may prove more deleterious than the lethal concentrations, because subtle and small effects on the fish may alter their behavior, feeding habits, position in the school, reproductive success, etc." (Exhibit 3)

10. Laboratory studies show that sublethal concentrations of pesticides can affect many aspects of fish biology. As part of its registration of pesticides, EPA may require registrants to supply studies that measure this type of impact after longer-term exposure to the test pesticide. These tests are known as chronic, early life-stage, or life-cycle tests, and they study impacts such as effects on survival, reproduction, appearance, and size, and behaviors such as mobility. If required, these tests are performed on a variety of test animals, including selected fish species and aquatic invertebrates. Some of the documented effects from these tests as well as other studies are summarized below.

11. The ability to feed, to avoid predators, and to defend and maintain territories in the river system all depend upon the swimming ability of the fish. Laboratory studies have shown that low concentrations of pesticides can alter swimming ability. Documented effects include reduced swimming speed, loss of stamina, and diminished orientation ability. Such

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interferences with swimming performance would reduce the ability to feed and avoid predators. Diminishing Returns at 19-21.

12. Many pesticides disrupt schooling behavior, which salmon utilize to evade predators during migration. Diminishing Returns at 22-23.

13. Several pesticides have been shown to cause fish to seek higher or lower water temperatures depending on the concentrations of pesticides to which they are exposed. In one study, salmonids sought lower temperature water at low concentrations of a pesticide, but, as the pesticide concentrations increased, the salmon sought warmer water to stimulate detoxification. The higher temperatures could subject the fish to increased dangers of disease and predation. Diminishing Returns at 22.

14. In addition to changes in behavior, there is some growing evidence that exposure to relatively low concentrations of pesticides can disrupt the immune system. Fish in polluted waters are subject to more frequent and more severe outbreaks of disease because many synthetic chemicals tend to suppress the immune system. Diminishing Returns at 27-28.

15. Pesticides can also affect the endocrine system. Endocrine systems control the production of hormones, which in turn control many other functions, such as sexual development and bone formation. Fish are especially vulnerable to endocrine-disrupting effects during early stages of development. The sexes of salmonids are not fixed until after the fry stages of development. Through exposure to sex hormones at early stages of development, genetic males may become physiologic females and vice versa. At low concentrations, pesticides have been shown to act as mimics of sex hormones or inhibitors of sex hormone development, causing abnormal sexual development, feminization of males, and abnormal sex ratios. Diminishing

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Returns at 29-35. A recent study on wild spawning chinook salmon in the Columbia River has shown the presence of male sex chromosomes in a high percentage of spawning female salmon, suggesting sex reversal in these fish.

C. INDIRECT EFFECTS

16. Sublethal concentrations of pesticides can indirectly affect fish populations by interfering with their food supply or altering aquatic habitat.

17. Such indirect effects include significant reductions in the abundance of food organisms, such as adult insects, insect larvae, and other invertebrates on which fish depend for their growth. Interference with salmonid growth has deleterious effects on smolting, immune function, predator avoidance, seaward migration, and seawater adaptation.

18. Removal of aquatic and terrestrial vegetation can decrease habitat suitability. When pesticides kill aquatic plants, small fish are more susceptible to predation. Removal of riparian vegetation can result in elevated water temperatures to sub-optimum levels, decreasing growth and increasing the risk of disease. Decomposition of aquatic plants killed by pesticides can lower the oxygen content of the water to levels that are lethal to salmonids. Insecticides that enter the water kill aquatic insects, a major food source for salmonids. Herbicides that enter the waterways kill algae and diatoms that are the food source for aquatic organisms that the salmonids use for food.

19. While these effects are subtle, evidence suggests that in complex ecosystems, indirect effects can be even more important than direct effects. For this reason, the impacts of pesticides on aquatic insects, invertebrates, and plants may be just as important indicators of aquatic ecosystem health as the direct effects on the salmon. Diminishing Returns at 36-38.

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EVIDENCE THAT PARTICULAR PESTICIDES MAY ADVERSELY AFFECT SALMON

20. As described above, the acute toxicity of pesticides to fish is documented in LC_{50} studies submitted to EPA. A growing body of scientific evidence is revealing a wide array of effects of pesticides on salmon at concentrations far lower than the lethal dose.

21. Unfortunately, there are few comprehensive monitoring programs that document the presence and concentrations of pesticides in salmon-bearing waters. A recent report commissioned by the Oregon Legislature concluded that pesticides are detrimental to salmon, but "*[s]ince little monitoring is done to detect the presence of pesticides and fertilizers in streams, the level of exposure by fish to chemicals is largely unknown.*" Botkin et al. 1995 (emphasis in original). In my opinion, it is critical to conduct further studies, monitoring, and assessments of the impacts of pesticides on salmon. I understand that the consultations sought in this litigation would provide expert review of the impacts of particular pesticide uses on salmonids and their habitat. This expert review is an important step in understanding the unappreciated effects of pesticides at low concentrations on the biology of salmonids.

22. While much is unknown about the full range and extent of pesticide impacts on salmon, sufficient research and monitoring have been done to date to raise concerns about various pesticide uses. I have described above some of the scientific literature concerning pesticide effects on salmonids and their habitat. The water quality information from the National Water Quality Assessment Program ("NAWQA") of the U.S. Geological Survey ("USGS") provides evidence that certain pesticide uses are of particular concern.

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A. DETECTIONS OF PESTICIDES AT CONCENTRATIONS THAT EXCEED ESTABLISHED AQUATIC LIFE CRITERIA

23. Through the NAWQA, the USGS has conducted water quality monitoring in approximately 50 river basins and aquifers throughout the United States, called study units. Four of these study units coincide or overlap with the range of threatened or endangered salmonids and encompass critical habitat that has been designated for them.

24. The Puget Sound Basin study area coincides with the range of the Puget Sound Chinook Salmon evolutionarily significant unit ("ESU"), which has been listed as threatened. The Willamette Basin study area coincides with the range of the Upper Willamette Chinook Salmon ESU, which has also been listed as threatened. The San Joaquin-Tulare Basin system study unit overlaps the southern portion of the range of the threatened Central Valley California Steelhead.

25. In its published water quality assessments, the USGS has reported detections of pesticides in surface water in each of these basins. Water Quality in the Puget Sound Basin, Washington and British Columbia, 1996-1998 (2000); Pesticides in Selected Small Streams in the Puget Sound Basin, 1987-1995 (1997); Water Quality in the Willamette Basin, Oregon, 1991-1995 (1998); Distribution of Dissolved Pesticides & Other Water Quality Constituents in Small Streams, & their Relation to Land Use, in the Willamette River Basin, Oregon, 1996 (1997); Water Quality in the San Joaquin-Tulare Basins, California,1992-1995 (1998). (Exhibits 4-8). These detections are limited by the fact that the USGS surveyed for only a subset of registered insecticides and herbicides. The USGS did not survey for any fungicides other than pentachlorophenol nor for many herbicides and insecticides commonly used in the Northwest.

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Fungicides have been shown to be of special concern for salmonids for their potential endocrine disruptive effects or effects on predator avoidance.

26. To assess the potential risks posed by the detections, USGS compared the concentrations detected in surface water with aquatic life criteria that have been established for the particular pesticide. USGS found exceedances of aquatic life criteria for 14 pesticides. The chart below presents the detections that exceeded aquatic life criteria in the USGS surveys:

EXCEEDANCES OF AQUATIC LIFE CRITERIA

ACTIVE INGREDIENT

Azinphos-Methyl
Carbaryl
Carbofuran
Chlorpyrifos
Diazinon
Malathion
Trifluralin
Atrazine
Simazine
2,4-D
Diuron
Dicamba
Metribuzin
Lindane (gamma-BHC & HCH)

27. The aquatic life criteria have been set based on a variety of factors, including acute and sublethal effects on fish and other aquatic organisms such as aquatic plants and invertebrates. As the above discussion of pesticide impacts on salmonids shows, salmonid populations may be adversely affected both directly and by negative impacts to aquatic plants and aquatic invertebrates.

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28. A limitation of the USGS assessments stems from the small number of aquatic life criteria that have been established. EPA, through the Clean Water Act, has established aquatic life criteria for only a handful of insecticides and for no herbicides or fungicides commonly used today. Although other scientific bodies and regulators have established aquatic life criteria for some pesticides, less than two dozen of the more than 100 pesticides surveyed in the NAWQA surveys have aquatic life criteria from any source.

29. The USGS assessments of pesticide concentrations in major river systems provide examples of the pervasiveness and longevity of these chemicals in our waterways. Only a small number of the total pesticides available, and only the the active ingredients themselves, were examined because of budget limitations. From these limited studies, from the exceedance of aquatic life criteria found, and from the studies on effects of sublethal concentrations on fish, there is reason for concern about the effects of pesticides in our waterways on fish populations.

Pursuant to 28 U.S.C. § 1746, I declare under penalty of perjury that the foregoing is true and correct. Executed on this 19th day of April, 2001, at Corvallis, Oregon.

Richard D. Ewing

Richard D. Ewing, Ph.D.

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